SUBSTITUTE SPECIFICATION

DESCRIPTION

CONNECTION STRUCTURE FOR CONNECTING HEAT EXCHANGER TANK WITH CONNECTOR

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is the U.S. National Phase Application, under 35 USC 371 of International Application PCT/JP2004/003271, filed on March 12, 2004, published as WO 2004/081481 A1 on September 23, 2004, and claiming priority to JP 2003-069198, filed March 14, 2003, the disclosures of all of which are incorporated herein by reference.

TECHNICAL FIELD

The present invention relates to a structure that may be adopted when connecting a tank in a heat exchanger such as an evaporator with a device constituting a refrigerating cycle such as an expansion valve or a pipe via a connector.

BACKGROUND ART

A heat exchanger connector (may also be referred to as an expansion valve mounting member) bonded to an opening of a tank in a heat exchanger (such as an evaporator) to communicate with the inner space of the heat exchanger and having intake/outlet portions to which another component (such as an expansion valve) constituting a refrigerating cycle is directly connected and a heat exchanger having such a connector are known in the related art (see, for instance, Japanese Unexamined Patent

Publication No. H8-94209 and Japanese Unexamined Patent Publication No. H10-206069).

A connector connected to an opening of a tank in a heat exchanger and used to achieve a pipe connection with another component constituting the refrigerating cycle and a heat exchanger having such a connector are also known in the related art (see, for instance, Japanese Unexamined Patent Publication No. H9-72630).

In recent years, heat exchangers having tanks and heat exchanging tubes formed independently of each other are often manufactured by forming the tanks through extrusion molding in order to reduce the manufacturing cost and the like (see, for instance, Japanese Unexamined Patent Publication No. 2001-221590).

However, when the extrusion molding method is adopted in the tank production, it is difficult to clad the outer surface of a tank with a brazing filler metal. It is also difficult to clad the outer surface of a connector formed through machining with a brazing filler metal. Thus, when such a connector is to be bonded with the heat exchanging medium intake/outlet portions of the tank, a reliable manner with which the brazing filler metal to be used during the furnace brazing process is supplied needs to be worked out.

Japanese Unexamined Patent Publication No. 2001-221590 mentioned above, however, simply states in paragraph [0041] that "the connector 6 is bonded to the header pipe 3 through brazing", without mentioning any specific means for supplying the brazing filler metal.

The applicant of the present invention conceived a means for supplying a brazing filler metal material, achieved by disposing a brazing filler metal supplying member between the tank and the connector. In order to assure a reliable supply of the brazing

filler metal with the brazing filler metal supplying means, it must be ensured that the brazing filler metal supplying member does not come off prior to the brazing process.

Accordingly, an object of the present invention is to provide a reliable brazing filler metal supplying means for supplying the brazing filler metal to be used to braze a tank having no brazing filler metal layer formed at the surface thereof to a connector formed through machining while ensuring that the member constituting the brazing filler metal supplying means does not come off.

DISCLOSURE OF THE INVENTION

In order to achieve the object described above, a connection structure according to the present invention to be adopted when bonding a heat exchanger tank with a connector, comprising a heat exchanger tank having openings each formed at one of the two side ends thereof along the direction in which tubes are layered, a connector having at least either a heat exchanging medium intake portion or a heat exchanging medium outlet portion and a brazing filler metal supplying member having formed thereat a connecting hole to communicate between an opening at the heat exchanger tank and the intake/outlet portion at the connector, is characterized in that the heat exchanger tank is an extrusion-molded tank formed through extrusion molding, which is divided into a plurality of chambers along the width of the heat exchanger with a partitioning portion, and that the heat exchanger tank and the connector are brazed and bonded together with a brazing filler metal material supplied to the heat exchanger tank and the connector from the brazing filler metal supplying member held between one of the openings at the heat exchanger tank and the intake/outlet portion formed at the connecter. The connector may be formed through, for instance, machining, and is used to connect with a device constituting a refrigerating cycle such as an expansion valve. As the description

above implies, the connector, which includes at least either a heat exchanging medium intake portion or the heat exchanging medium outlet portion, may only have an intake portion or an outlet portion, as well as both an intake portion and an outlet portion. Namely, the present invention may be adopted in a heat exchanger having both an intake portion and an outlet portion disposed at an end surface on one side of the heat exchanger tank along the layering direction, or in a heat exchanger having only either an intake portion or an outlet portion disposed at an end surface on one side of the heat exchanger tank along the layering direction. The brazing filler metal supplying member may be a brazing filler metal-clad member having superficial layers of, for instance, a core member on the two sides, one toward the tank and the other toward the connector both clad with a brazing filler metal material, or it may be a brazing filler metal sheet constituted of a brazing filler metal material alone.

In addition, projected portions to be held at the heat exchanger tank and the connector are formed to extend outward at the brazing filler metal supplying member. No specific restrictions are imposed with regard to the quantity of projected portions, as long as there are at least two such projected portions.

In the structure described above, a recessed portion extending along the direction of airflow is formed on a side ranging along the direction of airflow at the outer edge of the opening at the tank and a recessed portion extending along the direction of airflow is also formed at a side of the connector ranging along the direction of airflow and located toward the brazing filler metal supplying member.

A projected portion extending along the longer side of the tank may be formed at the external circumferential edge of the opening at the tank, groove portions at which the projected portions are to be engaged may be formed at sides of the brazing filler metal supplying member, and groove portions at which the projected portions are to be

engaged may also be formed at sides of the connector toward the brazing filler metal supplying member. At least one such projected portion should be formed at a position on the upstream side along the direction of airflow and at least one such projected portion should be formed at a position on the downstream side along the direction of airflow. In addition, a second projected portion extending along the longer side of the tank should be formed at the partitioning portion, with an insertion whole at which the second projected portion can be inserted formed between connecting holes at the brazing filler metal supplying member.

The connection structure described above having a heat exchanger tank having openings each formed at one of the two side ends thereof along the direction in which tubes are layered, a connector having at least either a heat exchanging medium intake portion or a heat exchanging medium outlet portion and a brazing filler metal supplying member having formed thereat a connecting hole to communicate between an opening at the heat exchanger tank and the intake/outlet portion at the connector, may further comprise a first jig that is allowed to come in contact with a surface of the connector located on a side opposite from the side where the brazing filler metal supplying member is present and a second jig that is allowed to come into contact with a surface of the heat exchanger tank on a side opposite from the side where the connector is present, is characterized in that the brazing filler metal supplying member is held by first clamping the brazing filler metal supplying member between one of the openings at the heat exchanger tank and the intake/outlet portion formed at the connector, placing the first jig in contact with the connector, placing the second jig in contact with the surface of the heat exchanger tank on the side opposite from the side where the connector is present and then binding the first jig, the connector, the brazing filler metal supplying member, the heat exchanger tank and the second jig together with a binding member.

Recessed retaining portions are formed at the first jig and the second jig on the two sides of the heat exchanger 1 along the layering direction so that the jigs, the connector, the brazing filler metal supplying member and the tank can be wound together with the binding wire member with ease and also that the winding positions can be determined easily. The binding member may be, for instance a metal wire.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1(a) is a front view showing the overall structure of a heat exchanger that includes a heat exchanger tank according to the present invention and FIG. 1(b) is a side elevation of the overall structure of the heat exchanger, viewed from the side on which the heat exchanging medium intake/outlet portions are located;

FIG. 2(a) illustrates the tank disposed on the tube upper-end side in the heat exchanger in FIG. 1 and FIG. 2(b) illustrates the tank disposed on the tube lower-end side in the heat exchanger in FIG. 1;

FIG. 3(a) shows heat exchanging tubes and fins in the heat exchanger in FIG. 1 and FIG. 3(b) is a sectional view of a tank in the heat exchanger;

FIGS. 4(a), 4(b) and 4(c) show the structure of a connector that may be used to connect a tank to an expansion valve;

FIG. 5 illustrates a structure having a brazing filler metal supplying member disposed between the tank and the connector to enable brazing of the tank and the connector;

FIG. 6 shows an example of a variation of the embodiment shown in FIG. 5;

FIG. 7(b) illustrates an example in which the brazing filler metal supplying member is held in a manner different from all of the preceding embodiments and FIG.

10(b) shows the surface of the brazing filler metal supplying member on the opposite side;

FIG. 8 is a partial sectional view showing the connector, the brazing filler metal supplying member and the tank in an assembled state; and

FIGS. 9(a), 9(b) and 9(c) illustrate the connector, the brazing filler metal supplying member and the tank held on the two sides along the longer side of the tank by using jigs and metal wire.

BEST MODE FOR CARRYING OUT THE INVENTION

The following is a detailed explanation of the present invention, given in reference to the attached drawings.

A heat exchanger 1 shown in FIGS. 1, 2 and 3 is used as an evaporator that constitutes a refrigerating cycle in, for instance, an automotive air-conditioning system. The heat exchanger 1, which is assembled through furnace brazing, includes a pair of tanks 2 and 3, a plurality of heat exchanging tubes 4 communicating between the tanks 2 and 3, corrugated outer fins 5 layered so as to alternate with the heat exchanging tubes 4, side plates 6 and 6 disposed further outward relative to the outer fins located at the two ends along the layering direction and a connector 9 disposed at one end of the tank 2 along its longer side. In this embodiment, the connector 9 includes a heat exchanging medium intake portion 7 and a heat exchanging medium outlet portion 8, and is connected with an expansion valve (not shown).

In the heat exchanger 1, the heat exchanging medium fed from the expansion valve (not shown) flows into the side of the tank 2 where a chamber 10 is located via the intake portion 7, the heat exchanging medium is then allowed to travel between the tanks 2 and 3 via the heat exchanging tubes 4, heat exchange with the air passing

between the outer fins 5 is induced as the heat exchanging medium travels between the tanks and finally the heat exchanging medium is let out from the side of the tank 2 where a chamber 11 is located via the outlet portion 8.

As shown in FIG. 3, the heat exchanging tubes 4 are oblate tubes each having the two ends thereof along the lengthwise direction, which are inserted at the tanks 2 and 3, formed as open ends, with a heat exchanging medium flow passage 13 formed therein and inner fins 14 housed therein. The heat exchanging tubes 4 are formed by rolling a single thin sheet member constituted of metal with a high level of conductivity such as aluminum in the embodiment.

The tanks 2 and 3, which are disposed so as to face opposite each other over a predetermined distance, are extrusion-molded tanks each having as its principal structural component, a cylindrical body 16 formed through extrusion molding. For this reason, no brazing filler metal layer is clad on the surfaces of the cylindrical bodies 16.

To explain the tanks 2 and 3 mainly in reference to FIGS. 3(b) and 5, the tanks 2 and 3 each include a tube insertion hole formation surface 16A where tube insertion holes 15 at which the heat exchanging tubes 4 are inserted are formed. While each tank includes openings 20 formed at the two ends along the longer side thereof, the openings 20, except for the one located near the connector 9, are blocked off with caps 12, as shown in FIGS. 1 and 2. The tanks 2 and 3 each include a partitioning portion 18 formed as an integrated part of the cylindrical body 16 so as to extend along the direction in which the heat exchanging tubes 4 are layered as shown in FIG. 5 and thus, the space inside each of the tanks 2 and 3 is divided into the chamber 10 and the chamber 11 defined side-by-side along the direction of airflow.

The chambers 10 and 11 at the tank 2 are each partitioned along the direction of airflow and thus, the chambers 10 and 11 are further divided into sub-chambers 10a and

10b and sub-chambers 11a and 11b respectively. In order to achieve a four-pass flow of the heat exchanging medium, the sub-chamber 10b and the sub-chamber 11b are made to communicate via a communicating passage 17. The chambers and 11 at the tank 2 are respectively divided into the sub-chambers 10a and 10b and the sub-chambers 11a and 11b by inserting partitioning members 21 formed as separate members independent of the cylindrical body 16 through slits 19 and 19 formed at the cylindrical body 16 of the tank 3.

As shown in FIG. 4, the connector 9 is constituted with a connector main body 22 assuming the form of a block, the heat exchanging medium intake portion 7 passing through the connector main body 22 and the heat exchanging medium outlet portion 8 likewise passing through the connector main body 22. As the connector 9 is formed through machining, no brazing filler metal layer is clad on the surface of the connector main body 22. In this embodiment, the width of the openings 20 and 20 at the tank 2 is smaller than the distance between the intake portion and the outlet portion at the expansion valve (not shown) and, for this reason, the intake portion 7 is formed by offsetting an extension valve-side intake 7A and a tank-side intake 7B with the two intakes 7A and 7B made to communicate with each other at an approximate center of the connector main body 22. The outlet portion 8 in the embodiment assumes a substantially cylindrical shape over the area ranging from the connector main body 22 through an approximate center and is flattened along the vertical direction over the area ranging from the approximate center through the tank 2.

Since neither the surface of the cylindrical body 16 at the tank 2 or the surface of the connector main body 22 at the connector 9 is clad with a brazing filler metal layer, a brazing filler metal supplying member 23 is held between the tank and the connector as

a means for connecting them to each other, as shown in FIG. 5, instead of directly placing the openings 20 in contact with the intake/outlet portions 7 and 8.

This brazing filler metal supplying member 23 may be a brazing filler metal clad member having a brazing filler metal material clad onto the surfaces of a core material on the two sides, one toward the tank 2 and the other toward the connector 9 or it may be a brazing filler metal sheet constituted of a brazing filler metal material alone. At the brazing filler metal supplying member 23, connecting holes 24 and 24 are formed so as to communicate with the openings 20 and 20 and the intake/outlet portions 7 and 8 at the connector 9. Thus, as the heat exchanger 1 is placed inside the furnace with the connecting holes 24 and 24 at the brazing filler metal supplying member 23 aligned with the openings 20 and 20 and the intake/outlet portions 7 and 8, the surface layer of the brazing filler metal supplying member or substantially the entirety of the brazing filler metal supplying member becomes melted and, as a result, the brazing filler metal is supplied into the space between the edge surface around the openings at the cylindrical body 16 and the connector main body 22, thereby enabling furnace brazing of the tank 2 and the connector main body 22.

At the brazing filler metal supplying member 23, four projected portions 25, each constituted as a thin tab projecting from an edge along the width of the tank toward the outside, are formed on both the upper and lower sides. Thus, by bending the projected portions as appropriate, e.g., by bending the two sets of projected portions 25 at the ends toward the tank 2 and bending the two sets of projected portions 25 at the center toward the connector 9, as shown in FIG. 6, the brazing filler metal supplying member 23 can be firmly fitted with both the connector 9 and the tank 2 even before the brazing process. As a result, the risk of the brazing filler metal supplying member 23 coming off

or becoming offset from the predetermined position while assembling the heat exchanger 1, transferring the heat exchanger 1 to the furnace and the like is eliminated.

In addition, as shown in FIG. 6, recessed portions 13 extending along the direction of airflow may be formed, each on one of the two sides of the surface ranging along the direction of airflow, at the edges of the openings 20 at the cylindrical body 16 constituting the tank 2, and recessed portions 26 and 26 extending along the direction of airflow on the two sides of the surfaces ranging along the direction of airflow at the outer edge areas of the intake and outlet portions 7 and 8 may be formed at the connector main body 22 constituting the connector 9 on the side toward the brazing filler metal supplying member 23. In this case, when the projected portions 25 at the brazing filler metal supplying member 23 are bent, their front ends can be inserted at the recessed portions 26, which will assure a higher level of coupling strength than that achieved by coupling the brazing filler metal supplying member with the cylindrical body 16 over flat surfaces.

Now, another embodiment that may be adopted when connecting the tank 2 and the connector 9 to each other is explained in reference to FIGS. 7and 8. It is to be noted that the same reference numerals are assigned to components similar to those in the previous embodiments to preclude the necessity for a repeated explanation thereof.

The embodiment shown in FIGS. 7 and 8 includes projected portions 34 and 34 each extending along the longer side of the tank 2 from a position at the external circumferential edge of an opening at the tank 2. In addition, groove portions 36 and 36 to engage the projected portions 34 and 34 are formed at the sides of the brazing filler metal supplying member 23 and groove portions 39 and 39 at which the projected portions 34 and 34 are also to be engaged are formed at the two sides of the connector 9 toward the brazing filler metal supplying member 23. A recessed portion 40 indented

inward is formed at each of the groove portions 39 at the connector 9 at a position on the side opposite from the tank 2. A projected portion 35 is formed at the partitioning portion 18 so as to extend along the longer side of the tank 2 from the end of the partitioning portion 18 where the tank 2 opens. Also, an insertion hole 38 passing through from the tank side to the side opposite from the tank is formed at the brazing filler metal supplying member 23 at a position between the connecting holes 24 and 24. It is to be noted that the projected portion 35 projects by an extent that allows it to project out beyond the insertion hole 38 toward the side opposite from the tank by a predetermined degree.

The structure described above enables, for instance, the following manufacturing steps. Namely, the brazing filler metal supplying member 23 is mounted at the tank 2 so as to engage the projected portions 34 at the tank 2 at the groove portions 36 at the brazing filler metal supplying member 23 and insert the projected portion 35 at the tank 2 through the insertion hole 38 at the brazing filler metal supplying member 23. With the projected portions 34 engaged at the groove portions 36 and the projected portion 35 inserted at the insertion hole 38, the brazing filler metal supplying member 23 being mounted at the tank 2 can be positioned with ease.

Next, the front end of the projected portion 35 projecting out beyond the insertion hole 38 at the brazing filler metal supplying member 23 is either bent or crushed. With this, it is ensured that the projected portion 35 does not slip out of the insertion hole 38 and thus, the brazing filler metal supplying member 23 becomes secured at the tank 2, which disallows any positional misalignment of the brazing filler metal supplying member 23 during the manufacturing process.

Then, with the projected portions 34 at the tank 2 engaged at the groove portions 39 at the connector 9, the intake/outlet portions 8 and 9 at the connector, which are

present toward the tank 2, are inserted through the connecting holes 24 and 24 at the brazing filler metal supplying member 23 and also through the openings 20 and 20 at the tank 2. Finally, the front ends of the projected portions 34 at the tank 2 are pressed into the recessed portions 40 at the connector 9 by forcibly pressing the front ends of the projected portion 34 inward, and thus, the tank 2 and the connector 9 are caulked together and the brazing filler metal supplying member 23 present between the tank 2 and the connector 9 becomes held firmly on both sides by the projected portions 34 and 34.

With the tank 2, the brazing filler metal supplying member 23 and the connector 9 fitted firmly together as described above, the connector 9 or the brazing filler metal supplying member 23 is not allowed to come off inside the furnace during the brazing process.

While the tank 2, the brazing filler metal supplying member 23 and the connector 9 are firmly fitted together by interlocking the projected portions 34 at the tank with the groove portions 36 at the brazing filler metal supplying member 23, the groove portions 39 at the connector 9 and the recessed portions 40 at the connector 9 as described above, the reliability of their coupling is further enhanced by inserting the projected portion 35 at the tank 2 through the insertion hole 38 at the brazing filler metal supplying member 23. However, the projected portion 35 and the insertion hole 38 are not essential structural requirements and they may be omitted in order to reduce the production costs.

Yet another embodiment that may be adopted when connecting the tank 2 with the connector 9 is explained in reference to FIG. 9. It is to be noted that the same reference numerals are assigned to components similar to those in the previous embodiments to preclude the necessity for a repeated explanation thereof.

In the embodiment shown in FIG. 9, the brazing filler metal supplying member 23 is held fast with two jigs 41 and 42 and a wire 44. Namely, the jigs 41 and 42 each include a retaining portion 45 assuming a semispherical recessed shape to hold the wire 44 in place. The retaining portions are formed on the two sides along the direction in which the tubes are layered to constitute the heat exchanger 1. While the jig 42 has an external shape having a sectional area substantially equal to the sectional area of the cylindrical body 16, the jig 41 assumes an external shape with a somewhat greater width along the direction of airflow than the connector 9 so as to retain the wire 44 easily. It is to be noted that air bleeding holes 43 through which the air in the heat exchanger 1 is released to the outside are formed at the jig 41 at the positions at which they will face opposite the openings at the intake/outlet portions 7 and 8 during the mounting process.

In this case, while the heat exchanger 1 is in a preassembled state with the brazing filler metal supplying member 23 disposed between the connector 9 and the cylindrical body 16 at the tank 2, the jig 41 is set in contact with the tank 2 and the connector 9, the jig 42 is set in contact with the surface of the tank 2 on the opposite side from the side where the connector 9 is present, the wire 44 is threaded through the recesses formed at the retaining portions 45 of the jigs 41 and 42 and the two ends of the wire 44 are tied together at a desirable position (the front side of the jig 41 in this example) by ensuring that the wire 44 is maintaining the desired level of tension. As a result, the connector 9, the brazing filler metal supplying member 23 and the tank 2 become bound and held together. Since this eliminates the need to form special portions at the connector 9, the brazing filler metal supplying member 23 and the tank 2 for preventing the brazing filler metal supplying member 23 from coming off, saving in the manufacturing costs is achieved.

INDUSTRIAL APPLICABILITY

According to the present invention, a tank and a connector can be brazed in a furnace with ease with a brazing filler metal supplied into the space between the tank and the connector from a brazing filler metal supplying member without having to clad a brazing filler metal material onto the outer surfaces of the tank and the connector while manufacturing a heat exchanger having the intake portion and the outlet portion both disposed at an end surface of the heat exchanger tank on one side along the layering direction or a heat exchanger having only either the intake portion or the outlet portion disposed at an end surface of the heat exchanger tank on one side along the layering direction. As a result, it becomes substantially possible to use a heat exchanger tank formed through extrusion molding in combination with a connector formed through machining.

In particular, according to the present invention, projected portions formed at the brazing filler metal supplying member are bent to hold onto the tank and the connector, which makes it possible to hold together the tank, the brazing filler metal supplying member and the connector in a stable manner prior to the brazing process to eliminate the risk of the brazing filler metal supplying member coming off prior to the brazing process and to facilitate the manufacturing process.

According to the present invention, the brazing filler metal supplying member, the tank and the connector are held together even more firmly, and thus, the tank, the brazing filler metal supplying member and the tank can be coupled in an even more stable manner.

In particular, according to the present invention, projected portions formed at the external circumferential edge of the tank are made to engage with groove portions formed at the brazing filler metal supplying member and then with groove portions

formed at the connector. Since this allows the tank, the brazing filler metal supplying member and the connector to be held together in a stable manner prior to the brazing process, the risk of the brazing filler metal supplying member coming off prior to the brazing process is eliminated and the manufacturing process is facilitated. Holes extending toward the center may be formed at the groove portions of the connector, and the front ends of the projected portions may be bent inward to be inserted at these holes.

In addition, according to the present invention, a second projected portion formed at the partitioning portion of the tank is inserted at a hole formed at the brazing filler metal supplying member and then the second projected portion is crushed or the like inside the hole to prevent any misalignment, which might allow the opening on one side and the connecting hole on the other side to communicate with each other, from occurring during the brazing process. As a result, the tank and the brazing filler metal supplying member can be held together with even more accuracy and reliability.

According to the present invention disclosed in claim 8, special portions for preventing slippage of the brazing filler metal supplying member do not need to be formed at the connector, the brazing filler metal supplying member and the tank, and thus, the manufacturing cost can be lowered.